Computer Science GCSE – Paper 1 - Unit 1 - Systems architecture

Context and Introduction to Unit: In this unit pupils will learn about the architecture of the CPU and how the performance of a CPU is measured. Pupils will learn what an embedded system is and the types of systems in which embedded systems are used.

Core Knowledge:

Architecture of the CPU

CPU stands for **Central Processing Unit**. It is the part of the computer that fetches and executes the **instructions** that are stored in **(main) memory**. Purpose is to process data and instructions. Function is to carry out Fetch – Decode – Execute cycle..
o The fetch-execute cycle

Common CPU components and their function:

1. Control Unit – Controls execution of instructions / decodes instructions / controls the flow of data around the CPU
2. ALU – Logical operations / arithmetic operations
3. Cache – Small, fast memory. Contains data frequently used by CPU
4. Registers - Registers are small amounts of high-speed memory contained within the CPU. They are used by the processor to store small amounts of data that are needed during processing,

Von Neumann architecture:

MAR / memory address register - Stores the address where data will be **read/written/accessed/fetched**
MDR / memory data register - Stores the data/instruction that is **fetched/read** from memory
Program counter - Stores the address/location of the next instruction to be run
Accumulator - Stores the result of manipulation/process/calculation

CPU performance

How common characteristics of CPUs affect their performance:

Clock speed

- How fast the CPU can carry out the FDE cycle.
- Measures in Hertz(H). How many cycles per second. Usually in GHz.

Cache size.

- Cache is small, fast memory located within the CPU.
- Stores copies of recently used data and instructions.
- RAM checks cache first before fetching data from RAM.
- Speeds up access because its faster to transfer from cache.

Number of cores

- A core is a copy of a CPU. More than one core – more instructions can be processed at one time because tasks can be split between processors.

Embedded systems

Embedded System: **A computer system that is built into larger device.**
Only performs one specific job and has a limited function, therefore efficient and uses low power.

Examples – Washing machine, lift, sat nav

Tier 3 Vocabulary:

Embedded
General Purpose
Processing
Memory
Cache
Cores
Clock speed

Computer Science GCSE – Paper 1 – 1.2.1/2 Memory and Storage

Context and Introduction to Unit: In this unit pupils will learn about memory and storage

Memory – Primary memory.

Stores data and programs currently in use.

Types of memory

- RAM – Random Access Memory
- Cache – Small, fast memory. Located in CPU. Stores copies of frequently used data / instructions.
- ROM – Read Only Memory
- Registers - Small super fast memory, contain one instruction / piece of data about to be processed by the CPU.

RAM - Random Access Memory

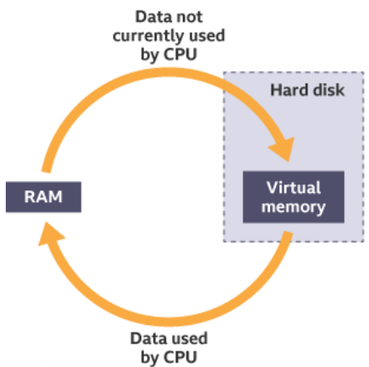
- Holds Operating system and applications software currently in use. Contains files and data currently in use.
- Can be read from and written to
- Volatile
- Measured in GB
- Upgraded easily.

ROM

- Contains BOOT up sequence / BIOS. Instructions computer needs to start up.
- Can only be read from not written to
- Non Volatile
- MB

Virtual Memory:

- When a section of the HDD is used as RAM.
- Used when RAM is full.
- Idle programs are sent to HDD.
- Frees up space in RAM.
- Allows more applications to open when RAM is full



- Using virtual memory makes a computer run slower, as the processor has to wait while data is swapped between hard disk and RAM. Secondary storage is much slower to access than RAM.

Secondary Storage:

A computers long term, non volatile storage.
Without secondary storage, all data / files and software would be lost when the computer was switched off.

Secondary storage can be internal or external

Types of secondary storage devices

- Hard Disk Drive – Internal
- External Hard Drive - External
- Solid State Drive - Internal
- USB Drive – External
- SD Card – External
- CD/ DVD – External

Common types of secondary storage

Magnetic storage devices, such as hard disk drives

- Huge Capacity / Low cost
- Moving parts / not portable / Affected by magnetic fields

Solid state storage devices, such as solid state drives and USB memory sticks

- Very portable / large capacity / no moving parts / Faster than HDD
- SSD are more expensive compared to HDD

Optical storage devices, such as CD, DVD and Blu-ray discs

- Cheap / Very portable, Lightweight
- Very slow to read/write data, slower than HDD

Suitable devices and storage media for a given application

The choice of secondary storage medium depends on the use it is required for. When deciding on the type of device needed, a user should consider:

- Cost - what is the cost per gigabyte (GB)?
- Capacity - how much data can the medium hold?
- Speed of access - how quickly can data be transferred to and from the medium?
- Portability - how portable is the medium? Does it need to be portable?
- Durability - how robust is the medium, and how robust will it need to be?
- Reliability - how resilient and long-lasting is the medium?

Tier 3 Vocabulary:

Memory
Storage
ROM
RAM
Virtual Memory
Volatile
Magnetic
Optical
Solid State
Characteristics
Registers
Cache

Computer Science GCSE – Paper 1 – 1.2.3/4 Data Representation

Context and Introduction to Unit: In this unit pupils will learn about how binary is used to represent characters, images and sound

Core Knowledge:

Units of Data

Bit Byte KB MB GB TB PB

Binary

- Binary is a base 2 number system that only uses two digits: 1 and 0.
- All information that is processed by a computer is in the form of a sequence of 1s and 0s.
- Denary, also known as "decimal" or "base 10," is the standard number system used around the world.

Binary Addition

- There are four rules that need to be followed when adding two binary numbers. These are:
  0 + 0 = 0
  1 + 0 = 1
  0 + 1 = 1
  1 + 1 = 0 carry 1
  1 + 1 + 1 = 1 carry 1
- Adding two binary numbers we can end up with an extra digit that doesn't fit. This is called an overflow error.

Binary Shifts

- To multiply a number, a binary shift moves all the digits in the binary number along to the left and fills the gaps after the shift with 0:
- to multiply by two, all digits shift one place to the left
- to multiply by four, all digits shift two places to the left
- To divide a number, a binary shift moves all the digits in the binary number along to the right:
- to divide by two, all digits shift one place to the right
- to divide by four, all digits shift two places to the right

Representing Characters

Character Set - The complete set of letters and symbols available within a given code

ASCII	A character set represented by 8 bits. Represents European languages
Unicode	A modern standard character set which uses 16 bits and includes many international languages

..

Hexadecimal

1. Hexadecimal uses a Base-16 number system. It has 16 units (0-9) and the letters A, B, C, D, E and F.
2. Hex 1 = 1, or the Hex A = 10, B = 11 and so on….

Representing Images

- Images are broken down into pixels
- Each pixel is represented by a binary number.
- The binary number represents the colour of the pixel
- The more bits there are to represents pixel, the greater the colours that can be chosen and the better the quality of the image.

Colour depth refers to the encumber of bits used per pixel.
Resolution refers to the number of pixels there are in an image.

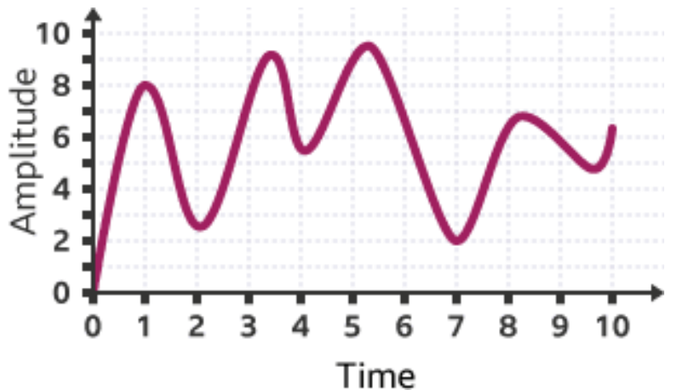
Each extra bit doubles the range of colours that are available:
- one bit per pixel (0 or 1) - two possible colours
- two bits per pixel (00 to 11) - four possible colours
- three bits per pixel (000 to 111) - eight possible colours
- four bits per pixel (0000 to 1111) - 16 possible colours
- 16 bits per pixel (0000 0000 0000 0000 to 1111 1111 1111 1111) - over 65,000 possible colours

Meta data
Data about the file itself
- File type
- Date created
- GPS location
- Colour depth
- Height of image
- Size of image

Representing Sound

- Sound wave is sampled at regular intervals
- The height of the sound wave / amplitude is measured at key intervals
- Each sample is stored as a binary number

Sample Rate – Number of samples recorded per second. Measured in Hertz.
Bit Depth – Number of bits used to record each sample. The higher the bit depth, the more accurately the sound can be recreated.
Bit Rate = Sample rate x bit depth



Tier 3 Vocabulary:

Binary
Base
Shift
Hexadecimal
Resolution
Character Set
ASCII
Unicode
Colour Depth
Meta Data
Sample Rate
Bit Depth
Sample Rate
Hertz
Overflow

Computer Science GCSE – Paper 1 – 1.3.1 Networks and topologies

Context and Introduction to Unit: In this unit pupils will learn about the types of networks and the different topologies,. Pupils will learn about the hardware needed to create a network and how the performance of a network can be improved.

Core Knowledge:

LAN – local Area Network
WAN – Wide Area Network

LAN	WAN
Small geographical area	Large Geographical area
Own hardware	Rent / lease hardware

Factors Effecting performance of a network

Bandwidth - How much data can travel per second. Measured in Mbps
Number of users on network
Wired / Wireless transmission
Latency – The delay between sending and receiving data on a network
Users --- Wired / wireless ----Latency

Network Hardware

NIC – Allows devices to connect to a network
WAP – Wireless Switch
Router – Transmitting data between networks – used in WAN.
Receive packets
Forward/sending/transmitting packets / Assigns IP address.
Switch – Connect devices on a LAN / Direct/send data/packets/traffic only to its destination / Uses MNAC addresses
UTP – Copper cables
Fibre Optic - Transmits using light

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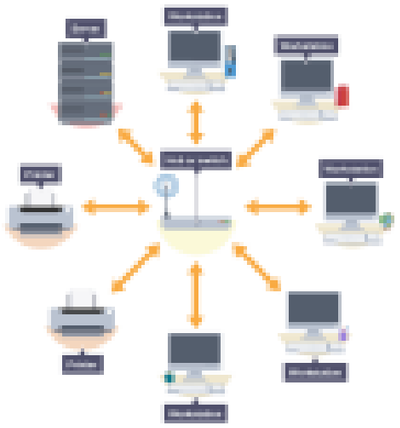
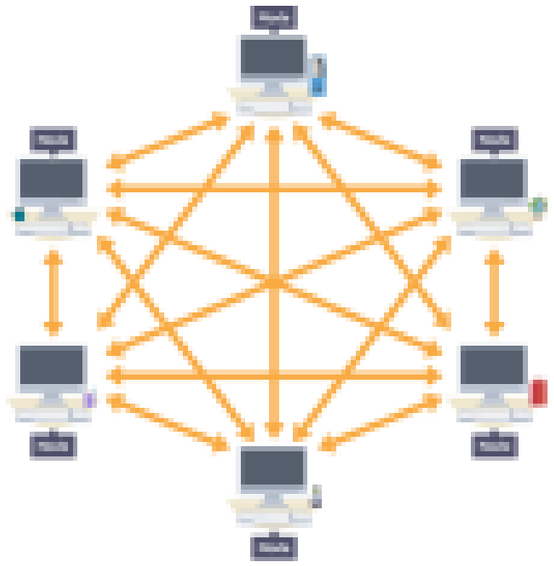


Star
Add more devices easily / Better performance as fewer data collisions
Switch or server fails – so does network / Expensive

Mesh
Advantages - Decentralised/ Data finds fastest route
Disadvantages - Can be expensive if wired

Full mesh – all devices connected to each other
Partial Mesh – multiple routes to each device but not all connected to each other.



DNS (Domain Name Server)
- Websites are hosted on a webserver.
- A webserver is a computer dedicated to storing websites
- A website / webserver has an IP address.
- A URL is typed into a browser. A browser is a client which sends requests to the DNS.
- The URL is sent to the DNS to look up the corresponding IP address
- IP address returned to browser..

Host - A server that stores files for other computers to access
The Cloud – Online storage of files / software.
- Advantages (Additional storage / don't need network manager / more environmentally friendly / save money on security and backing up date/ can access data from any device|)

- Disadvantages (Reliant on third party for security and backup / need constant internet connection / transferring data to cloud means potential for security breaches and hacking)

Tier 3 Vocabulary:

- Network
- Bandwidth
- Latency
- Transmission media
- Router
- Switch
- UTP
- Fibre Optic
- Network topology
- DNS
- URL
- Webserver
- Client
- IP address
- Hosting
- Cloud storage

Computer Science GCSE – Paper 1 – 1.3.2 Wired and wireless networks, protocols and layers

Context and Introduction to Unit: In this unit pupils will learn about the different transmission media in a network. They will learn about network protocols and the concept of layers.

Transmission media - How data is carried from point A to point B physically, either
by cable or wirelessly.
Wireless – Wireless transfer of data e.g. Wi-Fi / Bluetooth Ethernet

- Advantages (Faster to set up a network as no need for physical connections)
- Disadvantages (Slower than wired / can be impacted by interference such as physical obstructions)

Wired - Using physical wires to transfer data e.g. UTP / fibre optic / Ethernet

- Advantages (Larger bandwidth and lower latency)
- Disadvantages (Difficult to set up as need for physical connections)

Ethernet - A set of protocols used in a wired local area network that describes how data is transmitted within it.
Wi-Fi - A method of connecting to the internet wirelessly using radio waves.
Bluetooth - Wireless technology used for transmitting data over short distances.

Encryption - Used secure data across network Connections. Data is scrambled using an algorithm from plain text into cypher text. To de-crypt the message the receiving device must have the cypher key.

IP address A unique address for each computer device on a network.

MAC address Media access control - each unique piece of hardware on a network has a MAC address.

- IP addresses can be changed / are allocated as needed
- MAC addresses can't be changed / every device has a fixed MC address
- IP(v4) addresses are 4 bytes long
- MAC addresses are 6 bytes long
- IP(v4) addresses are normally written in denary
- MAC addresses are normally written in Hex
- IP addresses are configured by software
- MAC addresses are configured in hardware
- IP addresses are used for routing across a WAN / internet
- MAC addresses are only used within the LAN

Standard - An agreed way of doing things.

Common Protocols

Protocol A set of rules for how messages are turned into data packets and sent across networks

Protocol	Definition
TCP/IP	Transmission Control Protocol/Internet Protocol - enables communication over the internet.
HTTP	Hypertext Transfer Protocol - governs communication between a webserver and a client.
HTTPS	HTTPS (secure) includes secure encryption to allow transactions to be made over the internet.
FTP	File Transfer Protocol - governs the transmission of files across a network and the internet.
POP	Post Office Protocol – governs the transmission of emails to devices. Once downloaded to the device is deleted from the server.
IMAP	Internet Message Access Protocol – governs the transmission of emails. Stored on server and accessed by devices.
SMTP	Simple Mail Transfer Protocol - governs the sending of email over a network to a mail server.

Layers
Layering means to break up the sending of messages into separate components and activities. Each component handles a different part of the communication.
This can be referred to as the Transmission Control Protocol/Internet Protocol (TCP/IP) model.
Layering allows standards to be developed, but also to be adapted to new hardware and software over time. For example, different software packages (applications) may use the same transport, network and link layers but have their
own application layer. The way the program encodes the message changes – the rest of communication method remains the same

Tier 3 Vocabulary:

- Wired
- Ethernet
- Wireless
- Wi-Fi
- Bluetooth
- Encryption
- IP addressing
- MAC addressing
- Standard
- Protocol
- TCP/IP (Transmission Control Protocol/Internet Protocol)
- HTTP (Hyper Text Transfer Protocol)
- HTTPS (Hyper Text Transfer Protocol Secure)
- FTP (File Transfer Protocol)
- POP (Post Office Protocol)
- IMAP (Internet Message Access Protocol)
- SMTP (Simple Mail Transfer Protocol)
- Network layers

Computer Science GCSE – Paper 1 – 1.4 – Network security

Context and Introduction to Unit: In this unit pupils will learn about the threats to networks and the possible preventions to each threat.

Network Threats

1.6 SYSTEM SECURITY

TYPES OF ATTACK

Attack	How it works	How to prevent it
Passive	Network traffic is monitored and then data is intercepted	Encryption so that intercepted data cannot be understood
Active	Someone deliberately attacks a network with malware (eg: a virus)	A firewall and antivirus software
Insider	Someone with network access abuses this to steal information	User access levels to control how much data people can access.
Brute Force	Trial an error until a password is attacked	Making passwords difficult to guess. Locking accounts after failed attempts.
Denial of Service	The network is flooded with useless data so it is too slow to use	This attack is hard to prevent but a firewall can help.
SQL Injection	SQL commands are typed into the input boxes on a website to access data or alter the database	Having strong validation on all input boxes so that only expected data can be entered
Phishing	Emails with links that trick people into entering their personal information	Looking for signs that an email is not from a real company.
Social Engineering	When a person manipulates someone else into handing over sensitive information	Policies and rules for staff about handing over data. Staff training.

Malware - Software that is designed to cause harm or damage to a computer. This includes viruses that might damage files, adware that causes pop-ups, and spyware that collects and shares login details.

Denial of service attack - An attack designed to render online services inaccessible. One device simultaneously floods a target with network traffic. A distributed DoS is where multiple device flood a webserver.

Data interception - Where data is intercepted during transmission. This is done using software called a packet sniffer, which examines data packets as they are sent around a network.

Network Threat Preventions

Penetration testing - Systems are tested for vulnerabilities to reveal any weaknesses in the system which can be fixed.

Anti-malware A type of computer program which detects, prevents and removes malware on a system.

Firewall - An application that prevents unauthorised connections to and from the Internet.

User-access level - These are the permissions given to a user to access facilities on a computer.

Encryption - Files that are encrypted have been altered using a secret code and are unreadable to unauthorised parties.

Passwords- Can be used to prevent access to systems or files.

Physical Security- Locks on doors, CCTV, biometric entry, Alarms, security guards, Keycard entrty

Tier 3 Vocabulary:

- Malware
- Social engineering
- SQL
- Brite Force
- Interception
- Penetration Testing
- Malware
- Firewall
- Encryption
- Phishing
- Active
- Passive

Computer Science GCSE – Paper 1 – 1.5 – Systems software

Context and Introduction to Unit: In this unit pupils will learn about the different types of software in a computer system including operating and utilities.

System Software is designed to manage and maintain a computer system. The two types of system software are

1. Operating System
2. Utilities

Operating System The software that manages the hardware and software resources in a computer system. The operating system has five key features.

1. **User interface** The means by which a user interacts with a computer or device.
2. **Memory Management** - Managing where data is stored in which location in the main memory.
3. **Multitasking** The appearance of running more than one program simultaneously by switching the CPU processing time between different applications.
4. **Peripheral Management** - Device Drivers Software that controls and communicates with peripherals. Translates commands form hardware to software
5. **User management** Passwords and logins / Network access levels
6. **File management** - Rename / move / copy / delete files

Utility software A program which performs important maintenance tasks to improve the performance of a computer system.

1. **Encryption** - software Scrambling the data in files using an algorithm
2. **Defragmentation** The process of reordering files stored on a hard disk so that their segments run contiguously.
3. **Data Compression** A method of reducing file sizes, particularly in digital media such as photos, audio and video.
4. **Backup**

- Incremental – Taking a backup of new files that have been created. Quicker to take backups. Need to restore multiple backups if data lost which takes time.
- Full – Taking a back up of all files on a network. Takes time and uses a lot of storage. Easier to restore as only 1 backup.

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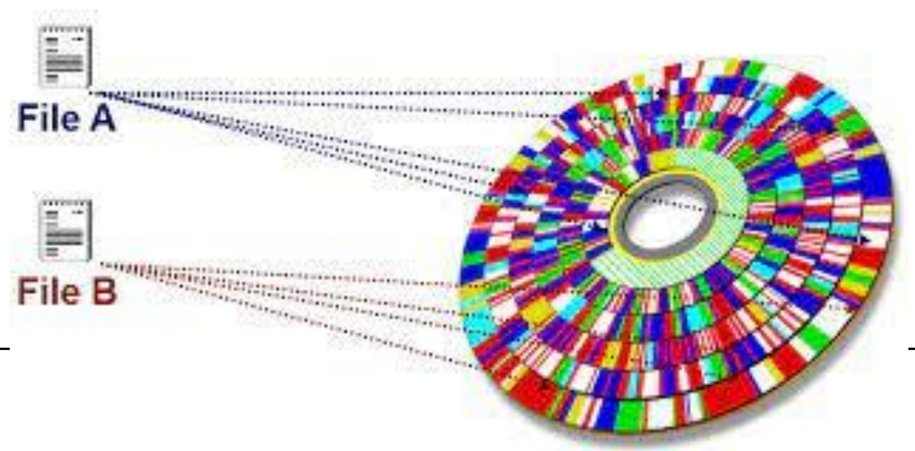
Defragmentation

When files are stored on HDD they are broken into segments. As new files are created and other files deleted, over time, file segments are not stored close to each other. This is known as fragmentation.

Defragmentation removed any gaps and reorders data so that files are stored sequentially and all free space is gathered together.



Tier 3 Vocabulary:

- System
- Operating software
- Interface
- Memory Management
- Multi tasking
- Peripheral
- Defragmentation
- Utilities

Computer Science GCSE – Paper 1 – 1.6 – Ethical, legal, cultural and environmental impacts of digital technology

Context and Introduction to Unit: In this unit pupils will learn about ethical, legal, cultural and environmental issues lined to the use of digital devices.

Impacts of digital technology

Ethical issues

Ethics are moral principles, or rules, which govern a person's attitudes and behaviour. Ethics apply to the use of computers as much as they do to other things in life. Ethical issues in computing include:

- Ensuring public safety
- Security of data

Cultural issues

The introduction of computers has changed society, sometimes for the better, sometimes for the worse. 'Cultural issues' is the term used for computer matters that have an effect on the nature and culture of society. Some of these issues include:

- The digital divide
- The changing nature of employment

Environmental issues

- Resources are needed to in order for computers to be produced, distributed and used. Metals and plastics are used to manufacture components, while energy is expended in distributing equipment and in using it.
- Many computers, such as web servers, domain name servers and data centres, need to be left running continuously. This requires lots of energy to maintain.
- Many computer components are either hard to recycle or contain toxic materials, such as lead.

Privacy issues

As more and more services become digitised users are worried about the amount of data organisations and governments gather. Eg Google Maps stores all data locations permanently unless opted out. Google know exactly where their users are, have been and for how long. This data is used for helpful purposes but it could also potentially be abused.

Legislation relevant to Computer Science

The Data Protection Act 2018

This law protects your data when used by companies and organisations. Personal data must be:

Fairly & lawfully processed	Obtained for legitimate purposes
Adequate, relevant & not excessive	Accurate & up to date
Not be kept longer than necessary	Handled securely.

Computer Misuse Act 1990

There are three separate parts to the Act:

1. It is illegal to access a computer unless you have permission to do so.
2. It is illegal to access data on a computer when that material will be used to commit further illegal activity, such as fraud or blackmail.
3. It is illegal to make changes to any data stored on a computer when the user does not have permission to do so.

Copyright Designs and Patents Act 1988

The **Copyright, Designs and Patents Act 1988** exists to protect peoples' creations. When a person creates something, they own it. What they create might include:

- a picture, drawing or photograph
- a video, television programme or film
- text, such as a book, article or report
- a game

Software licences

Open Source	Proprietary
Free of copyright	Copyright protected
Generally free	May have a fee or subscription licence
Source code is public	Source code is not public
Source code can be modified	Updates from manufacturer only
Possible online support from peers.	Can be expensive
Support may not be available	Cannot be modified
No guarantee of quality	Licence can limit number of installs

Tier 3 Vocabulary:

- Ethical
- Legal
- Cultural
- Environmental
- Legislation
- Privacy
- Surveillance
- Artificial Intelligence
- Open Source
- Proprietary
- Copyright
- Moral

Journey of Knowledge Computer Science GCSE – Paper 2 – 2.1 Programming fundamentals

Context and Introduction to Unit: In this unit pupils will learn how to write, test and refine flowchart and pseudocode algorithms,

Principles of computational thinking:

- Abstraction - Removing any unnecessary information to reduce complexity.
- Decomposition - breaking it down into sub problems. o
- Algorithmic thinking

Structure Diagrams represent the structure of a problem and how sub sections link to other sub sections.

Pseudocode - ERL

Selection (IF)

```
if entry==”a” then
    print(“You selected A”)
elseif entry==”b” then
    print(“You selected B”) else
print(“Unrecognised selection”)
    endif
```

Iteration – Loops

For loops

```
for i=0 to 7
     print(“Hello”)
next i
```

- **Syntax Error** – Error in the rules of the programming language. Program will not run.
- **Logic Error** –Error in the logic of the program. Program will run but not as intended.

Trace tables

One way to test short programs is to do what is known as a dry run using paper. A dry run involves creating what is called a trace table, containing all the variables a *program* contains.

While loops

```
while answer!=”computer”
     answer=input(“What is the password?”)
endwhile
```

```
do
     answer=input(“What is the password?”)
until answer==”computer”
```

Flowchart symbols

	Line		**Input/ Output**
	Process		**Decision**
	Sub program		**Terminal**

Searching Algorithms,

Binary Search

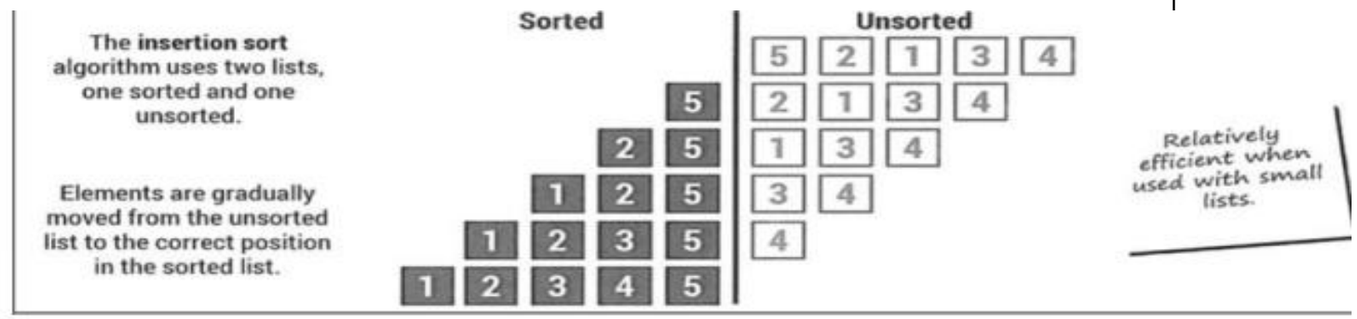
- Calculate a mid-point in the data set.
- Check if that is the item to be found.
- If not…
- If the item to be found is lower than the mid-point, repeat on the left half of the data set.
- If the item to be found is greater than the mid-point, repeat on the right

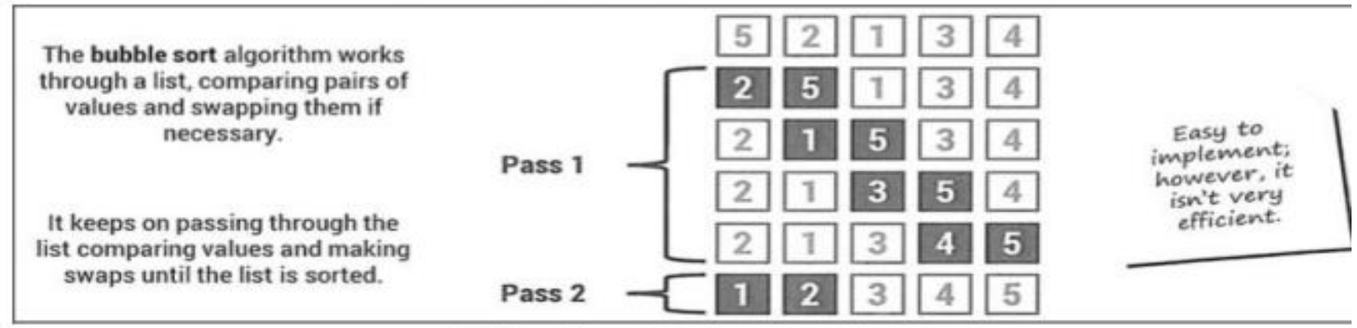
Efficient but complex algorithm.

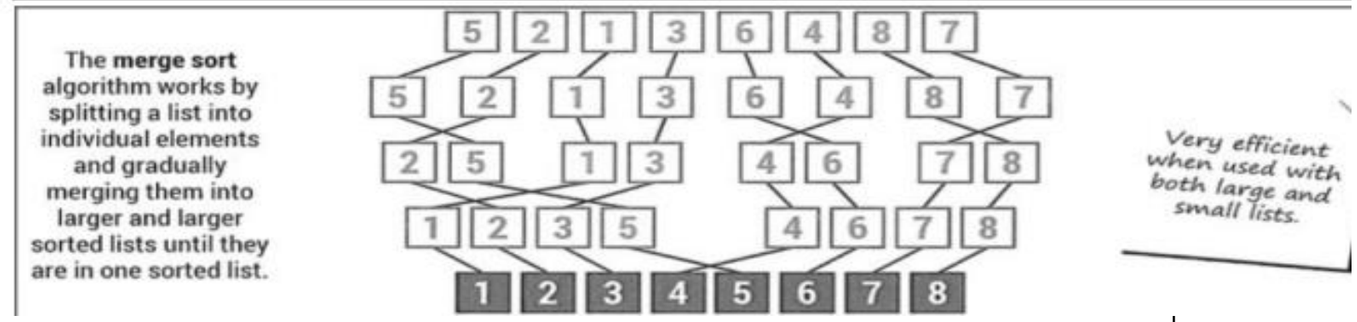
Linear search

- Checks each value in sequence.
- Not efficient – takes time with large data sets
- Simple algorithm

Sorting Algorithms







Key Words

- Abstraction
- Decomposition
- Algorithm
- Flowchart
- Pseudocode
- Syntax
- Logic
- Binary
- Linear
- Bubble Sort
- Merge Sort
- Insertion Sort

Journey of Knowledge Computer Science GCSE – Paper 2 – 2.2 Programming fundamentals

Context and Introduction to Unit: In this unit pupils will learn practical programming skills in Python along side key programming theory.

Programming Terms
- Casting – Changing from one data type to another
- Concatenation – Joining two strings together
- Variable – a named store of data that can change when the program is running
- Constant – A Named store of data that cant change when the program is running
- Assignment - An = is used to assign variables in Python

Program Flow
o Sequence – Instructions are executed in order
o Selection – Decision (IF statements)
o Iteration – Looping or repeating blocks of code (count- and condition-controlled loops)

Comparison operators

==	Equal to
!=	Not equal to
<	Less than
<=	Less than or equal to
	Division
>	Greater than
>=	Greater than or equal to

Arithmetic operators
DIV Quotient
MOD Modulus -
^ Exponentiation (to the power)

The use of data types:
- Integer – Whole number
- Real – Float / decimal
- Boolean – True / False
- Character - One character
- String – Letters / numbers / special characters “”
- Casting – Changing from data type to another

SQL – Structured query language

Statement	Explanation	Example
FROM	Name of table	FROM Customer_Details
SELECT	What data needs to be displayed	Name AND Address
WHERE	Criteria to meet	Age >=25

Data types	String “hello” Float (Real,. Decimal) float() Integer int() Boolean / Char – non python
Assigning variables	x = 7 y = “Ben”
Constants	x = 7 (Value won’t change for duration of program)
Outputting to screen	print (“Hello”)
Inputs	name = input(“What is your name?”)
Numerical operations	+ - * / % - MOD – returns remainder // - DIV – returns whole number
Logical operations	< > >= <= != ==
Casting – changing from one data type to another	str() int()
Concatenation - joining strings together	+ “hello” + “computer” hellocomputer
String handling	Length stringlength = len(string) substring substring = string[0:3]
Sequencing	Executing instructions in order
Selection - Boolean	and / or is x == 3 or x == 7
Selection statements – If	if elif else

Iteration - Looping	for loop
	for i in range (repeat):
	block of code
	
	for i in MyList :
	block of code
	
	while loop
	while num == 7:
	block of code

Arrays – Lists	1d - list = [2,3,4,5,1,2,3] 2d - list = [(2,3), (3,5), (6, 1)]
Functions	def nameoffunction(parameters): block of code return value returnvariable = nameoffunction(parameters)
Writing to files	file = open(“nameoffile.txt”, “w”) file.write(“hello”) file.close()
Reading from files	file = open("textfile.txt","r") TextFileVariable = file.read() file.close()

Tier 3 Vocabulary:

- Casting
- Concatenation
- Variable
- Constant
- Assignment
- Logical operator
- Sequence
- Selection
- Iteration
- Quotient
- Modulus
- SQL
- Array
- Function
- String

Journey of Knowledge

Computer Science GCSE – Paper 2 – 2.3 – Producing robust programs and 2.4 Boolean Logic

Context and Introduction to Unit: In this unit pupils will learn how to anticipate misuse of systems and methods to prevent misuse. In unit 2.4 pupils will learn about Boolean logic symbols and how to create truth tables for combinations of symbols to create logic circuits.

Unit 2.3

Input Validation - Checking that data meets criteria on input
Authentication Verifying the identity of a user.
Validation Checking input data is sensible and in the right format.

- Presence Check
- Length Check
- Data type Check

Maintainability The process of ensuring that a program is easy to understand, modify and update.

o Use of sub programs – Re-use blocks of code
o Naming conventions – Choose either CamelCase or under_score conventions for variables and stick to one.
o Indentation – Allows code to be easier to read
o Commenting – Use of comments to explain sections of code.

Testing

- **Iterative testing** Tests carried out while a program is being developed. Step by step.
- **Final/terminal testing** A test carried out when all parts of a program are complete.

Error Detection

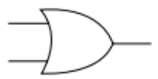
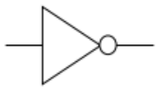
- **Syntax Error** Error in a program resulting from code not following syntax rules governing how to write statements in a programming language.
- **Logic Error** Error in a program which does not cause a program to crash but causes unexpected results.

Test data Data entered into a program to test if it is working.

1. Normal data Data entered into a program that should produce a positive result
2. Boundary data Data entered into a program at the edge of its acceptable range
3. Invalid data Data entered into a program that should produce a negative result.
4. Erroneous data Data that a program cannot process and should not accept.

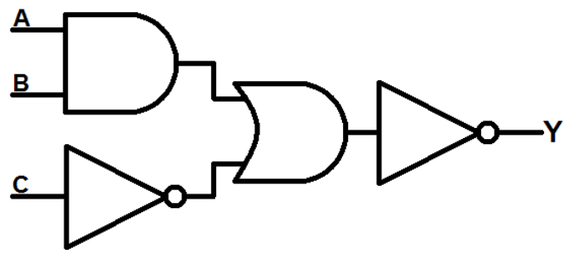
Unit 2.4

Simple logic diagrams using the operators AND, OR and NOT

Boolean Operators	Logic Gate Symbol
AND *(Conjunction)*	
OR *(Disjunction)*	
NOT *(Negation)*	

Combining Boolean operators using AND, OR and NOT

Y = NOT ((A AND B) OR (NOT C))



Truth tables

Truth Tables

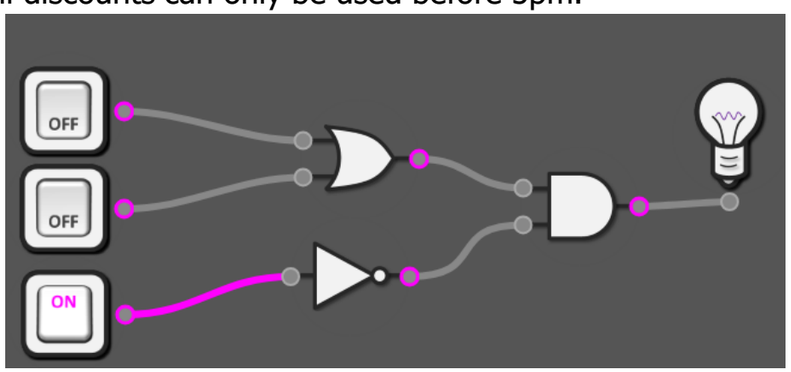
AND			OR			NOT	
A	B	A AND B	A	B	A OR B	A	NOT A
0	0	0	0	0	0	0	1
0	1	0	0	1	1	1	0
1	0	0	1	0	1		
1	1	1	1	1	1		

Applying logical operators in truth tables to solve problems
A cinema gives a discount if it is a Monday if the person has a valid discount card. All discounts can only be used before 5pm.

Monday?

Discount card

After 5 PM



Tier 3 Vocabulary:

- Validation
- Authentication
- Presence
- Range
- Maintainability
- Convention
- Indentation
- Syntax
- Logic
- Normal
- Boundary
- Invalid
- Erroneous
- Boolean
- Notation
- Conjunction
- Disjunction
- Negation
- Truth table

Journey of Knowledge

Computer Science GCSE – Paper 2 – 2.5 Programming languages and Integrated Development Environments

Context and Introduction to Unit: In this unit pupils will learn how to anticipate misuse of systems and methods to prevent misuse. In unit 2.4 pupils will learn about Boolean logic symbols and how to create truth tables for combinations of symbols to create logic circuits.

2.5.1 Languages Characteristics and purpose of different levels of programming language:

High-level languages

- human oriented code / written by programmers
- contains words for commands / closer to English / natural language
- Machine independent / Portable to different systems
- Needs to be translated before it can be executed.
- Problem based
- One (high level) command equates to many machine code instruction

Low-level languages

- Machine code is the set of instructions that a CPU
- Understands directly and can act upon. A program
- Written in machine code would consist of only 0s and 1s - binary
- Very difficult to write and debug

The purpose of translators

- To convert it to binary/machine code
- The processor can only understand machine code

Compiler

- To convert to low-level in one go
- Create an executable // export the file
- To distribute the software
- Users will have no access to source code…
- …so no-one can edit / steal / copy the code / program
- Use for error detection

Interpreter

- To convert to low-level line by line
- To test the program // to find errors
- stops running when it finds an error // shows the location of the error when found
- it is quicker (compared to compiler) to re-interpret than recompile

2.5.2 The Integrated Development Environment (IDE)

Software for writing code.

Common tools and facilities available in an Integrated Development Environment (IDE):

- Editors – line numbering, auto-colour coding. Auto – correct, auto-indentation
- Error diagnostics – Helps programmers find and fix errors. Tells the programmer the location of the error and possible solutions
- Run-time environment – Allows the code to be run within the IDE. Helps programmer spot errors and see what the program will look like for the user.
- Translator – translates the code into machine code
- Auto-documentation - and user manuals

Tier 3 Vocabulary:

- Machine code
- Processor
- Translator
- Compiler
- Interpreter
- IDE
- Editor
- Diagnostics
- Run-time